ABRASION-RESISTANT SLEEVE FOR WIRING AND THE LIKE

FIELD OF THE INVENTION

[0001] The present invention relates generally to a protective sleeve for covering a product subject to adverse environmental conditions and more particularly to a flat, knitted fabric cloth formed into a tubular fabric sleeve.

BACKGROUND OF THE INVENTION

[0002] Coverings for bundling loose items such as wiring, cables or tubing are generally known in the art. Such protective coverings include corrugated coverings, braided coverings and fabric coverings. To date, each of these types of tubular sleeves have been designed for and perform particularly well for a given function such as abrasion-resistance, flame retarding, high temperature or shielding of electromagnetic interference. However, many of the tubular sleeving designs require a specific fabrication for its given application. Thus, there remains a need for a common or universal means of fabricating a tubular sleeve in which the yarns within the sleeve are substituted, combined or interchanged based upon a given application.

SUMMARY OF THE INVENTION

[0003] The present invention is directed to a flat, crocheted fabric cloth which is formed into a tubular sleeve. The fabric cloth may be manufactured from a wide variety of yarns depending on the given application on a common machine independent of the yarns, and thus the application for the tubular sleeves.

[0004] Accordingly, the present invention is directed to an abrasion-resistant tubular sleeve having a monofilament forming a first weft in the fabric cloth, a first multi-filament yarn forming a second weft in the fabric cloth, and a set of crocheted warps including a plurality of textured multifilament yarns forming a chain stitch lap in the fabric cloth. The fabric cloth is crocheted in a flat configuration and then formed with a heating setting operation into a resilient tubular sleeve. In one embodiment of the present invention, a series of polyamide monofilament and multifilament yarns are utilized to provide an abrasion resistant tubular sleeve. In a second embodiment, a polyethylene terephalate (PET) monofilament yarn is used in conjunction with a series of polyester multifilament yarns. The PET monofilament yarn and the polyester multifilaments yarns are treated with a flame-retardant to provide a self extinguishing, abrasion-resistant no-burn-rate tubular sleeve. In a third embodiment, a polyphenylene sulfide monofilament yarn is used in combination with a textured Nomex®/Basofil® blend yarn to provide a high-temperature, abrasion-resistant tubular sleeve. In a fourth embodiment, a polyamide monofilament is utilized in conjunction with a series of stainless steel/polyester blend yarns, and polyester multifilaments yarns to provide a shielded, abrasion-resistant tubular sleeve.

[0005] Likewise, the present invention is directed to a method of fabricating an abrasion-resistant tubular sleeve including preparing a fabric cloth by chain stitching a set of multifilaments warps on a set of wefts including a monofilament weft and a multifilament weft, pulling the fabric cloth over a mandrel to form a tubular fabric sleeve, and resiliently setting the tubular fabric sleeve over the mandrel.

[0006] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0008] FIG. 1 is a partial perspective view of an abrasion-resistant tubular sleeve in accordance with the present invention;

[0009] FIG. 2 is a diagram showing a detailed illustration of the crocheted fabric cloth forming the tubular sleeve illustrated in FIG. 1;

[0010] FIG. 3 is an illustration of the pattern utilized to fabricate the fabric cloth shown in FIG. 2;

[0011] FIG. 4 is an exploded view of the pattern illustrated in FIG. 3; and

[0012] FIG. 5 is a flow chart illustrating the method of fabricating a tubular sleeve in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The following description of the preferred embodiments is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0014] With reference to FIGS. 1-4, the present invention is directed to a generally flat crocheted fabric cloth 12 formed into a resilient sleeve which maintains its tubular shape. The fabric cloth 12 includes a monofilament yarn 14 forming a first weft and a textured multifilament yarn 16 forming a second weft in the fabric cloth 12. Fabric cloth 12 further includes a set of crocheted warps in the form of textured multifilament yarns forming a chain stitch lap 18 in the fabric cloth 12. In a preferred embodiment, the fabric cloth 12 further includes a set of placed warps including a plurality of multifilament yarns forming a lay-in stitch lap 20 in fabric cloth 12. The lay-in stitch lap 20 is utilized to fill the spacing on the face of the fabric cloth 12 in between the chain stitch lap 18 to provide a smoother surface thereon. However, one skilled in the art will appreciate that a fabric cloth 12 may be fabricated without the lay-in stitch lap 18 and still be encompassed within the present invention. As used herein the term "yarn" is intended to include monofilaments, multifilament and combinations thereof.

[0015] As illustrated in the figures, the wefts 14, 16 are passed across all of the ends formed by warps 18, 20 for the width of the fabric from selvage 22 to selvage 24. The warp 18 is a crocheted warp formed as a closed-loop pillar stitch or chain stitch in the fabric cloth 12. The crocheted warp 18 is formed in each row of pins along the length of the fabric cloth 12. The placed warps 20 are formed by laying in the textured multifilament fiber between each row of the pins along the length of the fabric cloth 12. Thus, a chain stitch lap is formed along selvage. The fabric cloth 12 may be crocheted on any conventional machine capable of forming a two weft 14, 16 fabric with a set of chain stitch warps 18 and a set of lay-in warps 20.

[0016] With reference now to FIG. 5, the process for fabricating the abrasion-resistant tubular sleeve 10 is illustrated in a flow chart 100. Initially, a flat, fabric cloth 12 is formed having a monofilament weft 14, a multifilament weft 16, a crocheted multifilament warp 18 and a placed multifilament warp 20 as indicated at block 102. Once formed, the flat, fabric cloth 12 is pulled onto a generally cylindrical mandrel to form a tubular fabric sleeve 10 as indicated at block 104. The claim stitch lap 18 and lay-in lap 20 are oriented to be generally parallel to the longitudinal axis A-A of the tubular sleeve 12 (as shown in FIG 1.) As presently preferred, the tubular fabric sleeve 10 has an overlapped portion 26 (shown in FIG. 1) which preferably extends over approximately 25 percent of the tubular sleeve 12. In other words, the overlap portion 26 extends for approximately 90 degrees as indicated by the angle α shown in FIG. 1. Next, the tubular fabric sleeve 10 is heated while on the mandrel as represented by processing block 106. In this step, certain monofilament fibers within the tubular sleeve may be heat set once subjected to a suitable elevated temperature for a sufficient time period to a particular configuration. The parameters for heat setting the tubular sleeve 10 are generally dependent upon the type of filaments utilized in the fabric cloth 12. For example, a fabric cloth containing PET may be heated to a temperature to at least partially melt the PET to darker enhance the thermal set and bind the other yarns within the fabric cloth.

[0017] Next, the tubular fabric sleeve 10 is cooled to resiliently set the fabric cloth 12 in the rolled or tubular configuration as indicated at processing block 108. Lastly, the tubular fabric sleeve 10 may be cut or coiled from the otherwise running fabrication as indicated at processing block 110. Again, depending upon the

composition of the fabric cloth and the thermal setting process, a cutting step may be performed by mechanical shears or alternately by a thermal cutting process, both generally known in the art. The thermal cutting process has the additional benefit fusing the ends of the warps 18, 20 to prevent further fraying of the fabric cloth 12.

[0018] As previously indicated, the present invention may be readily adaptable to a variety of abrasion-resistant tubular sleeving products. Table 1 reproduced below indicates four exemplar compositions for an abrasion-resistant tubular sleeve 10 in accordance with the present invention. As used in Table 1, PA refers to polyamide, PE refers to polyester, PET refers to polyethylene terephalate, PPS refers to polyphenylene sulfide, N/B refers to a Nomex®/Basofil® blend, and SS refers to stainless steel. The prefix FR used in Example 2 refers to yarns having a flame-retardant treatment known in the art.

TABLE 1

Ex	Monofilament Weft	Multifilament Weft	Warp	Lay-in	Characteristic
1A	PA 6/6	textured PA 6/6	textured PA 6/6 multifilament	textured PA 6/6 multifilament	Abrasion Resistant
1B	PE over PA 6/6				
2	FR-PET	textured FR-PE	textured FR-PE multifilament	textured FR-PE multifilament	Flame-retardant
3A	PPS	textured N/B	textured N/B multifilament	textured N/B multifilament	High Temperature
3B	PPS with 2% Teflon				
4A	PA 6/6	SS/PE blend	SS/PE blend	textured PE multifilament	EMI/RFI Shielded
4B	PE over PA 6/6			PE over PET	

[0019] In the first preferred example, Example 1A, a fabric cloth is crocheted principally from yarns of a polyamide or Nylon material to provide an abrasion-resistant

tubular sleeve. Specifically, a Nylon 6/6 monofilament yarn having a diameter in the range of 0.007" to 0.015" (7-15 mils) is used as the weft 14. Alternately, as indicated in Example 1B, a monofilament yarn having a Nylon 6/6 core with a polyester coating may be substituted for the weft 14. A textured multifilament Nylon 6/6 yarn having a denier in the range of 1000 to 2000 (1000D-2000D) is used as the weft 16. A textured multifilament Nylon 6/6 yarn having a denier in the range of 100 to 400 (100D-400D) is used as the crocheted warp 18. A textured multifilament Nylon 6/6 yarn having a denier in the range of 50 to 400 (50D-400D) is used as the lay-in warp 20. In a most preferred embodiment, weft 14 is a 10 mil monofilament yarn, weft 16 is a 1000D multifilament yarn, warp 18 is a 400D multifilament yarn and warp 20 is a 100D multifilament yarn.

[0020] In the second preferred example, Example 2, a fabric cloth is crocheted principally from yarns of flame-retardant polyethylene terephalate and yarns of flame-retardant polyester to provide a self-extinguishing, no-burn-rate (SENBR) tubular sleeve. Specifically, a flame-retardant polyethylene terephalate monofilament yarn having a diameter in the range of 0.007" to 0.015" (7-15 mils) is used as the weft 14. A flame-retardant, textured multifilament polyester yarn having a denier in the range of 1000 to 2000 (1000D-2000D) is used as the weft 16. A flame-retardant, textured multifilament polyester yarn having a denier in the range of 100 to 400 (100D-400D) is used as the crocheted warp 18. A flame-retardant, textured multifilament polyester yarn having a denier in the range of 50 to 400 (50D-400D) is used as the lay-in warp 20. In a most preferred embodiment, weft 14 is a 10 mil monofilament yarn,

weft 16 is a 1000D multifilament yarn, warp 18 is a 400D multifilament yarn and warp 20 is a 100D multifilament yarn.

[0021] In the third preferred example, Example 3A, a fabric cloth is crocheted principally from yarns of polyphenylene sulfide and yarns of a Nomex®/Basofil® blend to provide a high-temperature tubular sleeve capable of withstanding 200°C. Specifically, a polyphenylene sulfide monofilament yarn having a diameter in the range of 0.007" to 0.015" (7-15 mils) is used as the weft 14. Alternately, as indicated in Example 3B, a monofilament yarn having a polyphenylene sulfide with about 2% Teflon may be substituted for the weft 14. A textured Nomex®/Basofil® multifilament blend yarn having a denier in the range of 1000 to 2000 (1000D-2000D) is used as the weft 16. A textured Nomex®/Basofil® multifilament blend yarn having a denier in the range of 100 to 400 (100D-400D) is used as the crocheted warp 18. A textured Nomex®/Basofil® multifilament blend yarn having a denier in the range of 50 to 400 (50D-400D) is used as the lay-in warp 20. In a most preferred embodiment, weft 14 is a 10 mil monofilament yarn, weft 16 is 1000D mulitilament yarn, warp 18 is 400D multifilament yarn and warp 20 is 100D multifilament yarn. The blend of Nomex® to Basofil® in yarns 16, 18, 20 will be determined by the specific application and the processing parameters for the loom on which the fabric cloth is crocheted. However, a 60/40 Nomex/Basofil blend is presently preferred.

[0022] In the fourth preferred example, Example 4A, a fabric cloth is crocheted principally from yarns of a polyamide material, yarns of a stainless steel/polyester blend and yarns of polyester to provide tubular sleeve which provides shielding from electromagnetic interference (EMI) and radio frequency interference

(RFI). Specifically, a Nylon 6/6 monofilament yarn having a diameter in the range of 0.007" to 0.015" (7-15 mils) is used as the weft 14. Alternately, as indicated in Example 4B, a monofilament yarn having a Nylon 6/6 core with a polyester covering may be substituted for the weft 14. A textured multifilament stainless steel/polyester blend yarn having a denier in the range of 1000 to 2000 (1000D-2000D) is used as the weft 16. A textured multifilament stainless steel/polyester blend yarn having a denier in the range of 100 to 400 (100D-400D) is used as the crocheted warp 18. A textured multifilament polyester yarn having a denier in the range of 50 to 400 (50D-400D) is used as the lay-in warp 20. Alternately, as indicated in Example 4B, a monofilament yarn having a polyethylene terephalate core with a polyester covering may be substituted for the lay-in warp 20. In a most preferred embodiment, weft 14 is a 1000D monofilament yarn, weft 16 is a 1000D multifilament yarn, warp 18 is a 400D multifilament yarn and warp 20 is a 100D multifilament yarn. The blend of stainless steel to polyester in yarns 16, 18, 20 will be determined by the specific application and the processing parameters for the loom on which the fabric cloth is crocheted. However, a 20/80 stainless steel/polyester blend is presently preferred.

[0023] As described above, the present invention provides an improved fabric cloth construction for use in an abrasion-resistant tubular sleeve. The characteristics of the sleeve may be varied by varying the yarns, fibers and/or filaments without significantly changing the manufacturing process. In this regard, certain compositions have been indicated to provide abrasion resistance, flame-retardant , high temperature capability and/or EMI/RFI shielding. Moreover, certain preferred yarn dimensions have been provided for the fabrication of a tubular sleeve having a diameter in the range of 5

mm to 38 mm. However, one skilled in the art will appreciate that the dimensions of the filaments, as well as the dimensions of the fabric cloth forming the tubular sleeve may be varied in accordance with the specifications of a particular application. Likewise, additional monofilaments and/or multifilaments may be added to the weft yarns and/or warp yarns for adding additional structure and function to the tubular sleeve. Furthermore, while the composition of each fabric cloth has been described with specific reference to a particular characteristic, one skilled in the art will appreciate that a combination of characteristics may be provided by combining one or more of the described embodiments. As such, the description of the invention provided herein is merely exemplary in nature and, thus, variations that do not depart from the jest of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.